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ABSTRACT

This document presents guidelines on the organization of short courses and workshops on the dissemination of data in science and technology. Such courses can be either of a "stand-alone" nature or they can constitute scientific data components of more general courses in information science. These courses are intended for documentalists, information officers, and librarians who deal with scientific and technological information, as well as scientific research workers. The guidelines have been prepared for the teachers and organizers of such courses. Four major themes are considered: (1) curriculum design; (2) instructional methods; (3) planning and administration; and (4) course evaluation. An extensive bibliography of course curriculum topics is included, and it is suggested that, with appropriate updating, the complete listing or selected portions of it might usefully be made available to the students of these courses. Four appendices contain the aforementioned 38-page bibliography; a directory of data sources for 12 branches of science and technology; an inventory of data sources on seven topics; and a listing of eight guides for the presentation of data. (Author/KM)

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Guidelines for the organization of short courses and workshops on the dissemination of data in science and technology

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GUIDELINES FOR THE ORGANIZATION OF SHORT COURSES AND WORKSHOPS ON THE DISSEMINATION OF DATA IN SCIENCE AND TECHNOLOGY

prepared by

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PREFACE

This document presents guidelines on the organisation of short courses and workshops on the dissemination of data in science and technology. It is based on experience gained over recent years in the organisation and implementation of short courses under the sponsorship of CODATA, Unesco and various national agencies. Such courses can be either of a 'stand-alone' nature or they can constitute scientific data components of more general courses in information science. These courses are intended for documentalists, information officers and librarians who deal with scientific and technological information, as well as scientific research workers.

The guidelines have been prepared for the teachers and organisers of such courses. Four major themes are considered: curriculum design, instructional methods, planning and administration, course evaluation. An extensive bibliography of course curriculum topics is included, and it is suggested that, with appropriate updating, the complete listing or selected portions of it might usefully be made available to the students of these courses.

CONTENTS

page

Chapter 1 The Role of Unesco and CODATA in Training Courses 1

Chapter 2 Curriculum Design 4

Chapter 3 Instructional Methods 18

Chapter 4 Planning and Administration 23

Chapter 5 Course Evaluation 30

Acknowledgements 32

Appendix 1 References 33

Nature and Variety of Data 34
Printed Sources of Data 34
Data Evaluation 35
Data Centre Organisation and Activities 36
Computer Management of Data 36
Data Dissemination 42
Data Referral 43
On-Line Service Centres and Marketing 44
Role of Intermediaries 45
Problems of Developing Countries 45
Role of CODATA and Other Organisations 46
Earth and Space Sciences 46
Physics 50
Chemical Structure and Spectroscopy 51
Thermodynamic and Other Physicochemical Properties 54
Crystallography, Materials and Metallurgy 59
Engineering and Energy Data 62
Environmental Data 64
Biosciences 66

Appendix 2 CODATA Directory of Data Sources for Science and Technology 71

Appendix 3 Inventory of Data Sources in Science and Technology A Preliminary Survey 72

Appendix 4 Guides for the Presentation of Data 73

CHAPTER 1

THE ROLE OF UNESCO AND CODATA IN TRAINING COURSES

Introduction

Over the past two decades there has been a dramatic increase in the number of computerised bibliographic reference services available to end-users and to intermediaries such as librarians, information officers and documentalists. Many of these services have been promoted by the organisation of seminars, workshops and training courses. Although the related published literature continues to grow unabated it is probably true to say that the problems facing the users of such services are concerned, not so much with the content of the databases, but rather with the impact of new technology on their use. Thus much attention is focussed on the use of on-line networks, microcomputers, user-friendly interfaces, downloading of information, and so on.

In contrast, the involvement of librarians and documentalists with scientific and technical factual data has, to this day, been concerned principally with the use of handbooks and other printed compilations of data. Surveys indicate that the growth rate for new factual databases is much higher than that for new reference databases but the majority of publicly available factual databases are concerned with commercial rather than with scientific and technical data. Nevertheless, the databases of science and technology are now sufficiently well-established that librarians and documentalists, especially in national information centres and in industry, are increasingly expected to be familiar with some of them and to use them in the search for data.

While it is true that a librarian or documentalist cannot be expected to have detailed subject expertise in the contents of a wide variety of factual databases, nevertheless it is important that he or she should have some understanding of the basic operations involved in the development of scientific and technical databases. Many of these operations have common features irrespective of the particular scientific discipline, and the range of data processing activities can be broadly grouped under the headings of: generation and collection, evaluation, compilation, dissemination.

It would thus seem important that efforts be made to organise suitable training courses for librarians and documentalists on the accessibility and dissemination of scientific and technical data. This document, based on the experiences gained in a number of such courses, has been written with the intention that it should provide guidelines for those who will be involved in the planning, administration and teaching of such courses.

The Role of Unesco

Unesco, through its General Information Programme, has, for many years, been concerned with current developments in libraries, archives and general scientific information. Since the early 1970s Unesco has also made a substantial contribution to a variety of activities relating to scientific and technical data. One such activity has been support, in the form of financial

assistance, to students from developing countries to enable them to participate in certain training courses which have been sponsored by Unesco and other organisations. This commitment to education and training is a major component of the on-going work of Unesco's General Information Programme.

The Role of CODATA

CODATA, the Committee on Data for Science and Technology of the International Council of Scientific Unions (ICSU), was established in 1966. It is not a committee in the normal sense of the word but can rather be considered as a multi- and interdisciplinary scientific Union. Its mission is summarised in its Constitution: "... CODATA, working on an interdisciplinary basis, shall seek to improve the quality, reliability and accessibility of data of importance to science and technology, including not only quantitative information on the properties and behaviour of matter, but also other experimental and observational data". In its 1973 report the Task Group on the Accessibility and Dissemination of Data recommended that "assistance should be provided [by CODATA] in the training of personnel required for data dissemination services".

Review of Past Courses

In accordance with their stated objectives, CODATA and Unesco have, over recent years, collaborated with various national bodies in the organisation of a number of training courses:

(a) International Training Course in Data Dissemination, Tsukuba, Japan, 1-4 October 1980.

(b) International Training Course on Accessibility and Dissemination of Non-Bibliographic Data for Science and Technology, Stockholm, Sweden, 15-22 October 1983.

(c) Post-Graduate Training Course for Science Information Specialists in Southeast Asia, Manila, Philippines, Training Sessions on Scientific Data, 7-11 April 1980; 13-18 October 1980; 26 October-6 November 1981.

(d) Cours post-universitaire pour la formation de spécialistes de l'information et de la documentation scientifiques; module sur les données numériques scientifiques et techniques, Lyon, Grenoble, France, 1982; 1983; 1984; 1985; 1986.

(e) Training Course on the Handling of Experimental Geoscience Data, Valbonne, France, 15-19 December 1980.

(f) Training Course on Data Management in Geoscience for Latin America and the Caribbean Region, Ouro Preto, Brazil, 7-12 December 1981.

In the above list, courses (e) and (f) differ from (a) to (d) in that they were more concerned with the statistical treatment of geoscience data rather than in the dissemination of such data. Thus these courses were more directed

towards database producers than towards librarians and documentalists. In this respect they were similar to courses on the treatment and critical evaluation of experimental data organised by CODATA and Unesco in Varazdin, Yugoslavia, 1976 and Poznan, Poland, 1977.

Course Framework

In general terms the course framework can be characterised with respect to four parameters viz. management, context, students, teachers.

(i) The course can be conducted at the international level with the organisational responsibilities vested in an international body, such as CODATA. Alternatively the course can be managed at the national or regional level, with external advice and support, as needed.

(ii) The context of the course can be either a 'stand-alone' unit or a component of a larger course. The courses which were conducted in Tsukuba, Stockholm, Valbonne and Ouro Preto were of the 'stand-alone' type, whereas those in Manila and Lyon, Grenoble were modules accommodated into 9-12 month postgraduate courses.

If the course is of the 'stand-alone' variety then, of necessity, the organising body must concern itself not just with the curriculum design but also with the planning and administration which are discussed in Chapter 4. If it is part of a larger course then the scheduling of the data component should be such that the students have, by that time, received adequate instruction in the more basic and simpler aspects of information science.

(iii) The students can be classified in terms of several factors such as scientific educational background, type of institution in which they work, whether they come from a developed or developing country, etc. These factors are of particular importance when selecting students for a 'stand-alone' course and will be discussed in Chapter 4.

It should also be noted that if a data module is offered as a component of a general training course in information science then some of the students may have little or no scientific background. This has been the case, for example, at the courses conducted in Lyon. In this situation the teachers must make special efforts to use simple examples of scientific data and seek to ensure that general principles are understood even though some of the scientific details are too specialised.

(iv) For the presentation of curriculum topics the teachers can be invited from abroad or they can be local or, at least, working in the country where the course is held. The combination of national and foreign teachers will very often be determined by economic considerations but the choice can have an important influence on the selection of topics for the curriculum. Thus, for example, generous local financial support for the Stockholm course enabled the organisers to invite a large number of Swedish teachers from very different scientific data areas. This afforded the students an excellent opportunity to broaden the scope of their awareness of scientific and technical data.

CHAPTER 2

CURRICULUM DESIGN

This chapter aims to identify major topics and sub-topics which could constitute the curricula of courses for librarians in the dissemination of scientific and technical data. General considerations of how the material might be scheduled and presented are discussed in the next chapter.

For the present purposes it is convenient to designate three categories of topics:-

- core topics
- general topics
- special topics

- Core topics: These deal with basic aspects of data collection, evaluation, management and dissemination. For the most part these topics are concerned with activities which are relevant to the broad range of scientific and technical data, e.g. computer management of data.

- General topics: Each general topic is concerned with the principal data activities in a particular field of science or technology, e.g. chemistry data.

- Special topics: Each special topic is concerned with the detailed treatment of a particular data topic in a particular subject area, e.g. printed sources of data in chemistry.

For a specific training course the precise way in which these categories of topics are combined to form a curriculum will obviously depend on the course objectives, teachers and students. Nevertheless, for the training of scientific and technical librarians, it is probably sufficient to consider two basic course types:-

- General Course

  Objectives: Such a course is designed to provide a general introduction to data dissemination activities in a wide variety of scientific and technical subjects.

  Students: The students would be drawn from a wide range of library/information situations but all would have a basic scientific/technical educational background.

  Curriculum: Core topics
  General topics - these would be selected, wherever possible, to match the job interests of the students.

- Specialised Course

Objectives: Such a course is designed to provide detailed instruction in the dissemination of data pertaining to a specific subject area, e.g. chemistry.

Students: The students would all be information professionals currently working in the subject area of the course.

Curriculum: Core topics
Special topics

(a) Core Topics

A reasonable set of core topics would be the following:-

(i) nature and variety of data
(ii) printed sources of data
(iii) data evaluation
(iv) data centre organisation and activities
(v) computer management of data
(vi) data dissemination
(vii) data referral
(viii) on-line service centres and marketing
(ix) role of intermediaries
(x) problems of developing countries
(xi) role of CODATA and other organisations

Some of these topics are also relevant to a study of bibliographic information systems but, wherever possible, the teachers should aim to compare and contrast the differences between reference and factual information. There can be considerable overlap of the contents of some of these topics but, in fact, this can be an advantage if the teachers come from very different professional backgrounds.

For each of the eleven topics, suggestions are now offered for sub-topics to be elaborated by teachers.

(i) **Nature and Variety of Data**

- definitions of data
- laboratory data of chemistry and physics
- observational data of earth sciences and biosciences
- engineering data
- multi-disciplinary data
- statistical data
- estimated data
- smoothed data
- classification of data by nature, presentation, expression, etc.
- classification of data with respect to users' needs
- data needs and data-seeking patterns
- types of data that are difficult to obtain

(ii) **Printed Sources of Data**

- primary scientific and technical journals
- abstract journals and indexes
- reference data journals
- standard reference data journals
- reports
- patents
- maps and atlases
- handbooks and data compilations
- encyclopaedias
- standards
- indirect sources - directories, guides
- data indexing
- data tagging and flagging
- data depositories

(iii) **Data Evaluation**

- need for data evaluation
- measures of reliability
- quality codes
- 'best' and 'recommended' values
- random and systematic errors
- data reduction
- choice of model
- presentation of results

(iv) **Data Centre Organisation and Activities**

- definition of coverage
- definition of user group
- analysis of user group needs
- review of existing services
- staffing and resources
- data collection by measurement/observation
- data collection by exchange mechanisms
- data collection from published sources
- abstracting, indexing, classification
- keyboarding
- checking
- evaluation
- extrapolation and interpolation
- selection of 'best' values
- correlation of related data sets
- testing of data against theoretical models
- database management
- software preparation
- provision of services
- user education

(v) **Computer Management of Data**

- assessment of user needs
- definition of data elements
- definition of data structures
- definition of data relationships
- requirements for input, output, search/query, report
- utilities
- prototypes
- software development
- access paths
- external interfaces
- documentation
- user training
- user support
- database administration
- security
- back-up and recovery
- costs

(vi) **Data Dissemination**

- indexes and annotated bibliographies
- bulletins
- data sheets and data compilations
- needs for enquiry services
- needs for on-line/off-line services
- needs for current awareness/retrospective searching
- role of intermediaries
- network architecture, telecommunication channels, terminals
- documentation
- training files
- user training
- national/regional user groups and feedback
- database security
- copyright
- downloading
- pricing policies

(vii) **Data Referral**

- location
- inventory of sources – coverage
  questionnaires
  classification
- files – manual
  computerised
  indexes
- work procedures – enquiries
  replies
  statistical control
  user assessment
- publicity
- publications
- staff selection and training
- office and computing resources

(viii) **On-Line Service Centres and Marketing**

- service centre requirements- computing power
  interfaces to telecommunications
  technical staff
  customer service staff
  management aids
- customer service - access, sign-on procedures
  service hours, reliability
  help desk
  on-line help
  manuals, reference cards
  contracts, invoices
  language
  pricing policy
  staff training
  evaluation
- interaction between staff and end-users
- interaction between staff and on-line vendors
- interaction between staff and database suppliers

(ix) **Role of Intermediaries**

- language
- knowledge of availability of databases
- selection of potential sources
- development of search strategy
- structuring and refinement of queries
- screening of search output
- acquisition of primary documents
- provision of referral services
- design/implementation of training courses/user manuals
- special assistance to infrequent users
- selection of terminals, networks
- assistance with password and other local procedures
- assistance with contracts
- assistance with marketing activities

(x) **Problems of Developing Countries**

- gaps - national policy for data provision
  developed science and technology infrastructure
  awareness of data services and data handling techniques
  human, institutional and financial resources
  maintenance facilities for hardware/software
  telecommunication facilities
- needs - adequate assessment of national user needs
  national referral/inventory facilities
  demonstration of existing resources
  implementation of pilot projects
  assistance in establishment of data systems
  improved access to external resources
  exchange of data

legitimate downloading facilities
educational activities
improved interfaces with end-users
increasing use of microcomputers
training in use of database management techniques

(xi) **Role of CODATA and Other Organisations**

- CODATA - reasons for its establishment
  aims
  formal structure
  task and working groups
  coordination of multi-national projects
  establishment of key data values
  guidelines for the presentation of data
  information on sources of reliable data
  conferences
  education and training
- role of Unesco, UNDP, WFEO, WHO, etc. in data dissemination activities
- role of national organisations in data dissemination activities.

(b) General Topics

As indicated at the start of this chapter, each general topic is intended to give an overview of the principal data activities in a specific field of science or technology. Obviously the precise items to be presented for a particular general topic will be decided by the teacher who is a subject specialist in that field. Nevertheless, on the basis of the experience of previous training courses and related activities, suggestions are now offered for possible data sub-topics relating to fifteen general topics:-

(i) biotechnology data
(ii) chemistry data
(iii) energy data
(iv) engineering data
(v) environmental data
(vi) fertilisers data
(vii) geodesy data
(viii) geology data
(ix) hydrology data
(x) materials data
(xi) nutrition data
(xii) pesticides data
(xiii) soil science data
(xiv) spatial data
(xv) standards data

(i) **Biotechnology Data**

- amino-acid and protein sequences
- cell and virus collections
- enzymes and enzyme engineering
- expert systems and pattern-seeking
- modelling
- microorganism culture collections
- molecular genetics
- nucleic acid sequences

(ii) **Chemistry Data**

- agrochemicals and pesticides
- drug data services
- patents
- process simulation systems
- property databases
- role of the Chemical Abstracts Service
- safety/environment databases
- structural representation
- traditional printed data sources

(iii) **Energy Data**

- analysis and monitoring
- biomass
- conservation
- conversion efficiency
- demand
- energy management
- environment
- geothermal
- hydropower
- materials
- nuclear
- ocean
- oil shales and tar sands
- solar
- spectral distribution
- standards and regulations
- statistics
- storage and transfer
- value
- wind

(iv) **Engineering Data**

- materials
  - property data
  - machinability
  - supply
  - costs
  - applications

- design
  - mechanical theory
  - design theory
  - performance evaluation
  - standards and regulations
  - user interface
- computers
  - CAD/CAM
  - performance analysis
- production
- service
  - feedback from in-service use
  - marketing and sales

(v) **Environmental Data**

- acid rain
- agriculture and food
- analytical and calibration procedures
- air
- biota
- carbon dioxide
- data reporting
- energy
- health and medicine
- land use
- legislation
- marine
- pollution
- quality control
- radioactive waste
- sampling methods
- soil
- standards
- sulfur
- toxicology
- transportation
- units and nomenclature
- wastes
- water
- wild life

(vi) **Fertilisers Data**

- agrometeorology
- chemical and physical analysis
- control and regulatory systems
- disposal of by-products
- environment
- minerals
- nutrition
- pedology
- pesticides
- plant protection
- soil science
- transportation

(vii) **Geodesy Data**

- cartography
- cosmic physics
- crustal dynamics
- earth tides
- gravimetry
- hydrography
- land surveying
- mean sea level
- polar motion
- rotation of the earth
- seismology
- solid earth geophysics
- time data

(viii) **Geology Data**

- economic geology
- environmental geology
- geochemistry
- geomorphology
- hydrogeology
- marine geology
- mineralogy
- palaeontology
- petrology
- sedimentology
- solid earth geophysics
- stratigraphy
- structural geology

(ix) **Hydrology Data**

- discharge measurements
- piezometric head
- quality and pollution
- sedimentation and sediment transport
- thermal waters
- underground water tables
- unsaturated zones

(x) **Materials Data**

- uses
  - material selection
  - component design
  - failure analysis
  - engineering analysis
  - purchasing
  - material subsitution
  - CAD/CAM and expert systems
- sources
  - handbooks
  - standards

technical societies
proprietary
supplier
databases

- characteristics - types
  standardised vs. experimental
  precision
  graphical
  tabular
  property relationships
  constraining properties
  estimation
  effect of class of materials

(xi) **Nutrition Data**

- products - composition of feeds and foods
  digestibility and availability of nutrients
  anti-nutritional factors
- requirements - nutrient requirements
  nutrient deficiency and malnutrition
  nutrition and health
- consumption - feed and food consumption
  feeding recommendations
  recommended dietary allowances

(xii) **Pesticides Data**

- names, trade marks, chemical constitution
- field of application - insecticide
  herbicide
  fungicide
  bactericide
  agaricide, etc.
- organisms
- host crops
- regulation and safety
- toxicology
- residue analysis

(xiii) **Soil Science Data**

- agricultural engineering
- agronomy
- arid zones or soils
- climatology
- crop production
- fertilisers data
- geochemistry and geology
- hydrology
- land use
- nutrition

- soil conservation and management
- soil map data
- soil taxonomy
- temperate zones or soils
- trace elements
- tropical zones or soils

(xiv) **Spatial Data**

- animal populations
- cartographic modelling
- climatology
- conservation
- crop distributions
- drainage
- fire hazards
- forestry
- geology
- groundwater
- land use planning and management
- maps and mapping
- plantations
- remote sensing technology
- soil characteristics
- topography
- transportation systems
- urban planning
- vegetation
- water resources management

(xv) **Standards Data**

- codes
- concensus
- metrological
- paper or documentary
- physical or artifactual
- product
- public or private
- regulatory
- safety
- standard reference data
- standard reference materials
- traceability
- voluntary

(c) Special Topics

As an example of curriculum design for a specialised course, this section will identify special topics in the area of chemistry data. In the previous section chemistry was listed as a general topic but in a general course only one or, at most, two hours would be allocated to chemistry. By contrast, in a specialised course, the items in the general chemistry topic would be extended

and treated in much greater depth, probably occupying two-thirds of the course, the other one-third being assigned to core topics.

Special topics for chemistry include the following:-

(i) **Structure Definition**

- nomenclature - the role of the IUPAC and the Chemical Abstracts Service (CAS)
- fragment codes - their use in the pharmaceutical industry
- notation systems - Wiswesser Line Notation, in particular
- topological representations - CAS connection tables and DARC descriptors
- representation of Markush structures

(ii) **Structure Searching**

- connectivity searching for - exact structures
  Markush structures
  sub-structures
- screening techniques
- molecular connectivity indexes
- use of WLN

(iii) **Role of the Chemical Abstracts Service**

- registry system
- Parent Compound Handbook
- structure searching via CAS Online
- data searching via abstracts
- data searching via full text

(iv) **Guides to the Literature**

- special textbooks - Bottle, Maizell, Woodburn, etc.
- principal directories - Aslib, CODATA, Cuadra, EUSIDIC, Kruszas, Williams, etc.

(v) **Printed Sources of Data**

- Beilstein
- Gmelin
- Landolt-Börnstein
- Merck Index
- Heilbron
- Index Chemicus
- Handbook of Chemistry and Physics and other CRC handbooks
- International Critical Tables
- JANAF Tables
- Solubility Data Series
- Journal of Physical and Chemical Reference Data
- Publications of the NSRDS

(vi) **Property Databases**

- characteristics
- examples drawn from
  - spectroscopy
  - crystallography
  - thermodynamics
  - electrochemistry, etc.

(vii) **Environmental/Safety Databases**

- wide variety of data content
- wide variety of data users
- examples such as ECDIN, RTECS, etc.

(viii) **The Chemical Information System (CIS)**

- architecture
- structure and nomenclature search system (SANSS)
- property databases
- environmental/safety databases
- regulatory databases
- data searching

(ix) **Property Estimation Systems**

- concepts
- examples such as
  - Physical Property Data Systems (PPDS)
  - Design Institute for Physical Property Data (DIPPR)

(x) **Chemical Process Simulation and Design**

- concepts
- examples such as
  - CHEMTRAN
  - CHESS
  - FLOWPACK II
  - FLOWTRAN
- work of the ASPEN project

(xi) **Chemical Data for Specific Industries**

- these industries might include:
  - agrochemicals
  - foodstuffs
  - metallurgy
  - petroleum
  - pharmaceuticals
  - plastics
  - polymers
  - etc.

(xii) **Legal and Regulatory Systems**

- copyright
- patents
- standards

CHAPTER 3

INSTRUCTIONAL METHODS

Scheduling

A primary objective in any training course should be to ensure that the instruction is provided in such a way as to promote maximum participation by the students. To achieve this objective the manner in which the curriculum material is designed, scheduled and presented will be of the utmost importance.

The schedule should be drawn up so as to obtain an appropriate balance between:

- lectures and discussion sessions
- demonstrations and films
- practical exercises
- student projects
- site visits
- refreshment/meal breaks, free time and social events

Past experiences suggest that course organisers are often tempted to pack too much instruction into the total available time. It should be borne in mind that, in the case of international training courses, the language of instruction is a foreign language for many of the students and for some of the teachers. While not advocating an overly leisurely presentation, the fatigue factor is very important, for both students and teachers, and allowance must be made for reasonable breaks and free time. Equally, time must be allocated for the students to discuss, among themselves, their various experiences and possible solutions to their data problems.

Local factors must also be considered in preparing the schedule. Thus, for example, a site visit should not be planned for a day which is a national public holiday. Another local factor is the climate, which might necessitate a long break at mid-day when temperatures are very high. Good liaison with the Local Committee should enable the organisers to schedule accordingly.

Lectures and Discussion Sessions

In most training courses lectures will constitute at least half of the syllabus and it is important that they are suitably interspersed with discussion sessions and other activities. Each lecture should last for no longer than one hour, including time for questions and the students should be encouraged to interrupt the teacher so that difficulties can be clarified as the lecture proceeds. If the more formal approach is adopted of reserving questions until the end of the lecture, then there is the danger that students may lose the thread of development of the topic and mentally 'switch off'. Again, the question of language must be considered. All teachers should be urged to speak relatively slowly and distinctly, using simple language which is free of unnecessary jargon and colloquialisms. Some of the language difficulties can be alleviated by the generous use of slides and viewgraphs.

Discussion sessions should form a very important component of the syllabus, and students at previous CODATA courses have expressed the opinion that there should have been more of them. Nevertheless, at these same courses quite a number of students were very reticent about contributing to the discussions and thus careful thought should be given by the teachers on how to format these sessions. In an attempt to overcome the shyness problem CODATA has asked students to come to the course prepared to speak to the class for, say, five minutes on what they normally do in their everyday jobs. The session in which they make these short presentations would be scheduled for some time during the first day of the course.

There are a variety of ways in which a discussion session can be formatted:

- one teacher or a panel of teachers discussing topics with the class
- the class divided into small groups and each group led in discussion by a teacher
- the class divided into small groups to discuss a topic by themselves and then to report back to the whole class for further discussion with the teachers.

In all probability, several of these formats, or others, may be used at any given course and the decision on which to use for particular topics may, in fact, be best decided after the first day when the teachers have had an opportunity to assess the students.

With regard to discussion topics, one can envisage the following general types:

- topics selected in advance of the course by the teachers
- topics which arise 'naturally' during the course as a result of particular lectures
- topics requested by the students during the course
- topics requested by the students in advance of the course.

In the last case one would expect these topics to relate to particular data problems experienced by the student in his or her day-to-day job. Such topics can well be discussed but they might also form the basis for student projects, as noted later in this chapter.

Demonstrations and Films

In this context the word 'demonstration' refers to a demonstration of the use of a computerised database or simulation package. This is an activity which the students usually enjoy. but the course organisers should not under-estimate the amount of planning which is necessary to achieve a successful demonstration.

Principal elements of the planning process are listed below:

- The course coordinator will, in consultation with the teachers, decide which databases should be demonstrated, in terms of relevance to the curriculum topics.

- The course coordinator, in collaboration with the Local Committee, will investigate the technical feasibility of accessing these databases from the course site. This will involve checking the availability of reliable power supplies, telephone communications, terminals, modems, printers, etc. It should be noted that the governments of some countries impose legal constraints on the use of the public telephone service for data processing - such factors must be carefully investigated.

- The course coordinator, in consultation with the teachers, will determine other access parameters - cost, account numbers, passwords, etc. If the course site is very remote from the host computers then time differences may allow the use of low off-peak tariffs.

- When all the necessary legal, financial and technical problems have been resolved then access to the various databases must be tested. Ideally some persons employed at the course site or nearby should be asked to test the systems some weeks in advance of the course. Even if this is successful, the systems should be tested again by the teachers when they arrive a few days before the start of the course.

- The students will be better able to appreciate a demonstration if the teacher first describes to them what they are going to see - database contents, search techniques, display features, etc.

- The actual demonstration must be sensibly organised in terms of physical comfort. Thus, for example, there should be no more than three students gathered round a terminal at any one time. Consideration might be given to the use of large-screen monitors and projection devices.

- For some databases video instruction tapes are available and, wherever possible, these should be available so that in the event of technical failures the demonstrations can still be conducted.

Scope for the use of films in such training courses is, at present, very limited. It is true that some very large national organisations and companies have produced films which, at a rather superficial level, demonstrate various kinds of data collection and analysis procedures. While these may be of general educational interest, they usually have no great relevance to courses in data dissemination and are probably best considered as providing some well-earned respite for the teachers and students.

Student Projects

In Chapter 2 the distinction was made between general courses, for a mixed audience of scientific/technical librarians, and specialised courses, for librarians in a specialised scientific/technical area, for example, chemistry. It is relatively easy to organise student projects in the latter, but the situation is much more difficult for general courses.

The principal problem with general courses is the diversity of scientific educational background of the students. As mentioned earlier, students could be required to submit, well in advance of the course, a statement of what kinds of data they have had difficulty in obtaining in the performance of their day-to-day jobs, and the teachers could then plan some projects based on these submissions. Organisation of such projects will require careful planning

on the part of the teachers to ensure that the appropriate resources, both printed and computerised, are available for the execution of the projects. If such projects are to be attempted then it would probably be prudent to select a small number of them and do them well rather than offer a larger number of less well-prepared projects. In tackling the projects the students should be organised in small groups rather than being asked to work individually.

The organisation of student projects for specialised courses should present no serious problems. In addition to searching for subject-specific data, these students should be encouraged to make assessments of the relevance of the retrieved data, especially with respect to data quality and reliability.

Site Visits

A visit to a local scientific/technical institute or industrial company can be an interesting part of the syllabus. Advice from the Local Committee should enable the course organisers to select one or more appropriate sites. It is important that the students are presented with a balanced view of the data activities at the site and thus should have an opportunity to meet scientists, librarians, managers, etc., who are concerned with data generation, capture, processing and dissemination. In arranging such a visit the site hosts should be appraised of the course objectives so that they can describe and demonstrate their activities at the appropriate level for the audience of students.

Another activity which could be regarded as a type of site visit is the arrangement made for the training course in Tsukuba, Japan in 1980. That course was deliberately scheduled to take place during the week immediately prior to the CODATA International Conference in Kyoto. Necessary arrangements were made in the course budget to allow the attendance at the conference of the students from developing countries. They thus had the opportunity to augment what they had learned in the course by the wide range of scientific and technical data activities discussed and demonstrated at the conference.

Hand-out Materials

Some course organisers recommend that students should be supplied with advance reading lists. If this is to be done, then the course coordinator should liaise with the teachers to ensure that the final list is not too large and that it is despatched to the students, say, 6 to 8 weeks before the start of the course. Since some students may have inadequate local resources, it may be difficult for them to access the suggested reading matter. To compensate for this, any advance reading list should be accompanied by a set of selected reprints. If these reprints are well chosen and relatively few in number, then there is a reasonable chance that students may make time to read them.

For budgetary reasons most hand-out material will be distributed at the course, and here also the materials should be carefully selected. The types of material to be supplied could include the following:

- a guide to the hand-out material indicating the nature of the documents and their relevance to specific topics in the course curriculum

- a glossary of scientific and technical data terms
- a limited set of reprints and brochures which describe general data topics and specific data systems and services (given sufficient advance notice, many data centres would be prepared to supply multiple copies of their relevant publications, free of charge or at nominal cost)
- a list of references for further reading
- photocopies of the teachers' slide material.

It should be stressed that the last item is one of the most valuable hand-outs, since it relieves the students of the need to transcribe the material shown on slides and thereby enables them to listen to what the teacher is saying and hopefully facilitate their understanding of the topic under discussion.

CHAPTER 4

PLANNING AND ADMINISTRATION

The planning and administration of a training course, especially one involving international participation, presents a host of logistical problems which must be tackled in an orderly and systematic fashion. Ten years ago a very useful set of guidelines for the organisation of training courses was published by Unesco (Atherton, P. Guidelines for the organization of training courses, workshops and seminars in scientific and technical information and documentation. UNISIST/SC/75/WS/29. Paris, Unesco, 1975. 88p).

This chapter focusses on some of the topics discussed in that report and draws on the experiences gained in the planning and administration of previous CODATA training courses. The topics to be considered are:

- formulation of course objectives
- assessment of necessary resources
- sponsorship
- organising committee
- action plan
- course announcement
- prospectus/application form
- design of curriculum and selection of teachers
- selection of students
- local facilities
- practical assistance to participants

Formulation of Course Objectives

As a starting point we can assume that a national or international organisation, either on its own intitiative or at the recommendation of some other body, has identified the need for a certain type of training course. If the 'parent' organisation feels a commitment to fulfilling this need then a small number of its members, acting as a planning group, must address the problem of formulating the objectives of the course.

To ensure a logical and coherent planning and implementation, the course objectives must be carefully specified. These will determine what human, physical and financial resources will be required, and they will also determine the professional setting from which the students will be drawn.

The course objectives will be enunciated in the publicity material which announces the course and they should be sufficiently precise as to enable potential students to assess whether or not the course would be relevant to their needs. It is equally important that the teaching staff coordinate their material so that the curriculum meets the stated objectives of the course.

Assessment of Necessary Resources

Having formulated the course objectives the planning group will then make a reasonably detailed assessment of what resources will be needed. Items to be considered include the following:

- optimum number of students
- number of teachers
- number of support staff (secretarial, etc.)
- preferred type of location for the course
- lecture rooms and associated facilities
- telecommunication facilities, access to network nodes, equipment testing
- accommodation requirements
- arrangements for meals

At this stage a draft budget must be prepared covering the anticipated items of expenditure. Since the budget will be calculated one to two years in advance of the course it is important to allow for inflation of costs. Budget items to be catered for include:

- secretarial costs
- printing of course prospectus/application forms
- postage, telephone, telex
- pre-course planning meeting(s)
- teachers' travel to the course
- teachers' subsistence allowance
- honoraria
- rental fees for facilities and equipment
- hand-out material for students
- production of post-course publication(s)

On the basis of an expected number of students and income from registration fees the budget will then reveal how much financial assistance must be sought from the course sponsors.

Sponsorship

The pattern of sponsorship for the courses held in Tsukuba and Stockholm was such that the local host country provided the major financial support. This was supplemented by a substantial contribution by Unesco and a smaller amount contributed by CODATA. The major part of the Unesco funds were assigned specifically to allow for the participation of students from developing countries. This type of fund-sharing proved very successful and is recommended for future international courses, wherever possible.

The course held in Tsukuba was intentionally scheduled to take place during the week immediately prior to the CODATA International Conference in Kyoto. In this way all the foreign teachers could be drawn from the conference participants, and this greatly reduced the funds necessary for teachers' travel. This arrangement is also very attractive to many teachers since it eases the demand on their time.

For international courses the principal thrust in seeking sponsorship should be to find a location which can offer the physical and human resources

which have been deemed necessary, and in a country with organisations willing to make a major financial contribution to the planning and implementation of the course.

Organising Committee

Having secured sponsorship for the objectives of the course and its location the planning group should then appoint an Organising Committee. Its members should be chosen to cover the following activities:

- pre-course planning and administration
- curriculum design
- local arrangements in the host country

It is important that the principal sponsors are represented on the Organising Committee and there should be one person who will also act as chairman of the Local Committee in the host country.

It will normally be necessary to designate a Secretariat which will be responsible for the implementation of the decisions of the Organising Committee. In many respects the Secretariat would best be located at the host institution or at the institution of the chairman of the Local Committee. However, the choice may well be influenced by other practical factors such as the efficiency of the postal services and telephones, language problems, relative time differences, etc.

Action Plan

The first, and crucially important, task of the Organising Committee is to prepare an action plan which identifies the chain of events leading up to the conduct of the course. The action plan must be placed on a realistic time scale with deadlines for each stage.

In previous CODATA courses the following action plan has proved to be effective:

- design the course announcement
- design the prospectus/application form
- print the prospectus/application form
- place the course announcement in appropriate newsletters, etc.
- send supplies of the announcement and prospectus/application form to national and international organisations
- make provisional reservation of accommodation facilities
- select the teaching staff
- design the curriculum
- candidates return completed application forms to Secretariat
- select students and notify them
- selected students confirm acceptance of offer to participate and pay registration fees
- confirm the reservation of accommodation facilities
- confirm that Local Committee has arranged for all local requirements
- send to students advance course material
- send to students and teachers practical notes on travel, etc.
- teachers arrive for review of curriculum and facilities

- students arrive
- conduct the course
- teachers and students depart
- prepare report and any derivative publications

The above items, though not necessarily exhaustive, indicate the principal planning stages. The list does not imply a strictly sequential chain of events, since some activities will proceed in parallel. However, deadlines must be set since the organisation of a training course should allow at least one year from the preparation of the action plan to the actual conduct of the course.

Course Announcement

A concise announcement of the course must be prepared which is suitable for publication in appropriate newsletters, bulletins, etc. These can be national, regional or international but it must be borne in mind that many newsletters are, at best, published quarterly so there could be a 3 to 6-month time lag before the announcement appears in print in certain newsletters. For Unesco-sponsored courses it is very important that the announcement is sent to all Unesco National Commissions so that they can channel it to the appropriate audience. A special effort should also be made to publicise extensively in the host country or region to encourage local participation.

The information to be included in the course announcement is:

- title of course
- names of sponsors
- location
- date
- course objectives, and level of presentation
- required background of students
- anticipated maximum number of students
- language of instruction
- cost - registration, accommodation, meals
- availability of financial assistance
- address and deadline for obtaining prospectus/application form

Past experience indicates that it is very important to announce a deadline for obtaining application forms. If this detail is omitted then the Secretariat will be involved in unnecessary correspondence and expense dealing with late enquiries.

Prospectus/Application Form

Some care should be taken to produce an attractive brochure which combines the course prospectus with a tear-off application form. The prospectus will amplify the information contained in the course announcement. In particular, the course objectives should be described with reference to the main topics which will be covered in the curriculum and, if at all possible, the names and affiliations of some of the teachers should be listed. Special attention should be given to an indication of the level at which the course will be conducted. This is important for candidates, from both developed and developing countries, in assessing whether or not the course is suitable for them.

The information to be supplied on the application form should include:

- name
- sex
- age
- nationality
- address for correspondence
- name and address of employer
- subject specialities
- professional education
- degrees held
- level of competence in the course language
- summary of current job activities (on separate sheet)
- need for financial assistance (fee, subsistence and/or travel). If travel assistance is requested then applicant should state approximate cost of round-trip travel
- release from duty declaration

The form should state the deadline for submission of the application and the address to which it should be sent. It should also indicate when the successful candidates will be notified that they are offered a place on the course.

An important section of the form is the 'release from duty' declaration. This should state that if the applicant is offered a place he or she will be released from normal duties to enable participation in the course. This declaration must be signed by the applicant's employer. Finally, it should be stressed to applicants that the requested summary of current job activities is very important. It will be considered very carefully in the selection of the students and failure to provide it will normally nullify the application.

Design of Curriculum and Selection of Teachers

The general 'shape' of the curriculum will have been embodied in the formulation of the course objectives. As a first step, it is important that someone, probably (but not necessarily) the chairman of the Organising Committee, be designated as curriculum coordinator. It is the responsibility of the coordinator to translate the basic objectives into a set of curriculum topics and to place these in a preliminary timetable schedule.

The coordinator, in consultation with appropriate persons, will then contact potential teachers to enlist their participation. In this process it is important to indicate the complete draft curriculum and schedule so that those who are invited to teach can assess the context of their contributions. As far as possible the coordinator should try to arrange for a core group of teachers to be present throughout the entire course. This will facilitate the organisation of discussion and practical sessions, and will lend some coherence to the instructional process. An appropriate balance should be struck between foreign and local teachers and the coordinator may find it very useful to draw on local expertise for a range of specific topics.

When most of the teachers have been secured then, if financial resources permit, there should be a meeting of the principal teachers to refine the curriculum and plan the instructional methods to be used. More likely, the budget will not allow such a meeting and the process will be carried out by

correspondence. One factor which may necessitate curriculum refinement, at least in emphasis, is the final selection of students. As soon as the list of students is determined, copies of their application forms and job description summaries should be sent to all teachers. Hopefully this will stimulate the teachers to present material which is of maximum relevance to the students.

Finally, as noted in the action plan, the teachers should be required to arrive at the course site at least two days in advance of the students so that they have adequate time for travel recovery, review of the schedule, testing of equipment, and so on.

Selection of Students

The principal criteria for selection are:

- the applicant should have an adequate educational background in science or technology and in information science
- the applicant's current job or job prospect is such that he or she would benefit from the stated course objectives
- the applicant must have a good command of the instruction language

As noted earlier, the candidate must submit, with his application form, a summary of current job activities. This statement will play a decisive role in the selection process. It is inevitable, especially for general courses (see Chapter 2), that the selected students will span a wide range of expertise and experience, particularly if they come from both developed and developing countries. However, provided that they all have the necessary level of scientific/technical education, then such diversity should provide a challenge to the teachers, both in the presentation of their lectures and in their conduct of discussion and practical sessions.

It is probably true to say that most candidates from developing countries will require financial assistance to cover travel, accommodation and registration costs. Furthermore, experience suggests that full support is required - offers of partial support generally only lead to protracted correspondence. Such considerations will, undoubtedly, play a part in the selection of students who need financial help.

Local Facilities

The responsibility for providing the necessary local facilities rests with the Local Committee but it will be helpful if the Organising Committee draws up a check list of the most important items, including the following:

- lecture and discussion rooms - number, size, ventilation, heating, air-conditioning
- office for use during the course
- photocopying, typewriter and telephone facilities
- blackboards, flip sheets, projection equipment for slides, viewgraphs and films, chalks, pens, erasers, pointers, noticeboards
- special facilities for computer use - text and graphic terminals, modems, telecommunication lines, printers, accounts, passwords, services of an engineer or technician during the course
- arrangements for site visits

- arrangements for social program
- arrangements for refreshments and meals
- transportation
- insurance
- hotel accommodation
- arrangements for participants' mail
- folders or bags for hand-out materials
- certificate of participation

In the event that the course is held at a very isolated location, special attention must be given to practical requirements such as the exchange of foreign currency, purchase of postage stamps, access to basic shopping facilities, etc.

Practical Assistance to Participants

When applicants are notified that they have been selected for the course they should be informed that they and the teachers will receive a package of practical information some 4 to 6 weeks in advance of the course. Experience suggests that the package should contain the following:

- complete course timetable
- names and affiliations of participants
- full postal address, telephone and telex numbers of the course office
- home address and telephone number of the local chairman (for emergencies)
- dates when participants should arrive
- where participants should report on arrival
- details of how to get from the airport or railway station to the course site, including how to use local public transport and what it costs; if possible, supply schedules for local trains and buses and indicate from which platforms they depart - such information is invaluable to participants who do not speak the local language
- instructions on how to use the public telephone system
- description of local currency denominations, existence of exchange facilities at the airport or railways station, restrictions relating to the local currency
- street and campus maps; also travel brochures supplied by the national tourist agency
- guidance on average temperatures and climate to be expected
- reminder to check visa and inoculation requirements.

CHAPTER 5

COURSE EVALUATION

An important aspect of any training course should be the evaluation of how effective it has been and what areas could be improved in the future. The whole question of course evaluation has been the subject of many studies and, in the context of scientific and technical information training courses, it has been comprehensively reviewed by Lancaster (Lancaster, F.W. Guidelines for the evaluation of training courses, workshops and seminars in scientific and technical information and documentation. SC.75/WS/44. Paris, Unesco, 1975. 63p., appendixes). The organisational review by Atherton (see Chapter 4) also contains helpful comments on the evaluation process.

If the course evaluation is to provide really useful information then it should be planned with some care. As Lancaster points out, a simple set of questions will enable the course organisers to plan how they will conduct the evaluation:-

- Who needs to know how effective the course has been?
- What do they need to know?
- Who can best provide this information?
- How can it be obtained most effectively and efficiently?

Who needs to know?

Those who need to know how effective the course has been include the sponsors, the Organising and Local Committees, the teachers and the students' employers. Each of these groups will have different viewpoints in assessing the evaluation and so must be appropriately catered for in deciding what questions to ask. Additionally, and not just as a courtesy gesture, the students themselves should be provided with the evaluation report so that they can compare their personal assessments with those of their fellow students.

What do they need to know?

The information to be gathered in the evaluation process relates to four general areas:-

(a) organisation
(b) curriculum and instructional methods
(c) students' expectations
(d) future actions

Drawing on the experience of previous CODATA training courses, the following questions could be asked:-

(a)
- How did you learn that the course was to take place?
- Was the administrative organisation satisfactory prior to the course?
- Was the administrative organisation satisfactory during the course?
- Were the physical arrangements (lecture rooms, accommodation, meals, transport, etc.) satisfactory?

(b)
- Did the contents of the course meet the stated objectives?
- Were any topics omitted which you had expected to be included?
- In future courses should some topics be expanded/contracted/omitted?
- Which topics were most/least valuable to you?
- Which topics were new to you?
- Which of these new topics did you find difficult?
- Which of the sessions did you find excellent/good/poor/uninteresting?
- Was the level of treatment adequate/too theoretical/too specialised?
- Was the balance between lectures, discussions, practicals, social events reasonable?
- Was there sufficient interaction between teachers and students?

(c)
- Why did you apply for the course?
- Did the course fulfill your expectations?
- What unexpected benefits did the course provide?
- Do you feel that the information gained in the course will be beneficial in your current job activities?

(d)
- Should further courses of this or other types be organised?
- In what ways could CODATA/Unesco help your institution or country to solve some of its scientific and technical data problems?

Who can best provide this information?

Undoubtedly the thrust of the above questions is directed at the students, and their answers will, to a large extent, determine the conclusions drawn from the evaluation process. However, it is also very important that other participants contribute to the evaluation. Thus the Organising and Local Committees should be asked to comment on the planning and administrative activities. Likewise the course coordinator and teachers should provide feedback on the curriculum design and instructional methods. They should also be asked to give their opinions on the abilities and attitudes of the students. Such information could be useful in the student selection process for future courses.

How can it be obtained?

Traditionally such information has been obtained by the use of questionnaires which are completed by the students and others at the end of the course, just before everyone departs. In practice, this is usually the only possibility afforded by a very tight time schedule and it is, therefore, appropriate to consider some simple guidelines which might help to improve the effectiveness of the exercise.

One person should be responsible for the collection of the information, and it is his or her duty to draft the final list of questions. The total number of questions should not be too great and each question must be worded in simple and unambiguous language. To avoid misunderstandings it is worthwhile setting aside 5 to 10 minutes to clarify any questions which the students find 'difficult'. The responses to the questions should be written on separate sheets or, to facilitate replies and analysis, using blocked questionnaire forms.

One of the major problems associated with such questionnaires is that some students will tend to write what they think the teachers wish to hear rather than give perfectly honest opinions. To some extent this can be offset by requesting that the students do not sign their completed reports. Another approach to the problem of anonymity would be to divide the students into 3 or 4 groups, appoint a leader for each group, give each group time to discuss the questions and then ask each leader to submit a report on behalf of his or her group. For each group the leader would be one of the more dynamic students or, preferably, someone from the host institution who is 'neutral' and has not been closely involved in the planning, administration or teaching of the course.

As indicated earlier, the completion of the questionnaires is often done just before the students depart. At that time many of them are very tired and their thoughts are more concerned with their departure and imminent travel. If the course is, say, of 6 days' duration then it would be advantageous to set aside time for the questionnaire exercise on the afternoon of the fifth day. It is unlikely that opinions will change dramatically as a result of what happens on the final day but, in any event, a short session of, say, 20 minutes could be allocated on the final day for any further contributions to the evaluation. This approach also has the merit of affording time during the last evening for refinement of the reports.

Thus far the discussion has been concerned with the collection of information at the end of the course. However, it should be borne in mind that, for longer courses, there is a real need to obtain feedback from the students as the course progresses. It is not suggested that this be done by questionnaires but rather in an informal way by discussions between the teachers and students, either in the lecture room or, preferably, during meal and coffee breaks.

Another aspect of course evaluation is the so-called post-course evaluation. This would involve writing to students and their employers 12 to 18 months after the course in an effort to learn whether or not the students have really benefitted from the course, especially in terms of what knowledge gained at the course they have been able to apply in their day-to-day job activities. Another point to be pursued in such a follow-up would be to ascertain whether a student was sufficiently stimulated by the course to seek to persuade local organisations in his or her country or region to sponsor similar courses. Undoubtedly such long-term evaluation could be useful to organisations such as CODATA and Unesco but, with few exceptions, this has not been done with respect to the courses which have so far been conducted in the field of scientific and technical data dissemination.

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APPENDIX 1

REFERENCES

This appendix provides references to publications concerning the eleven core topics discussed in Chapter 2 and to eight broad scientific data areas. The Proceedings of the Biennial CODATA Conferences constitute a very rich source of information on scientific and technological data, and the bulk of the references are drawn from these publications.

To conserve space the abbreviation CCPn is used to indicate the Proceedings of the n^{th} CODATA Conference. The necessary bibliographic details are as follows:-

CCP5: Dreyfus, B. (ed.). Proceedings of the Fifth International CODATA Conference, Boulder, Colorado, U.S.A., 28 June - 1 July, 1976. Oxford, Pergamon Press, 1977. xxvi, 642 p.

CCP6: Dreyfus, B. (ed.). Proceedings of the Sixth International CODATA Conference, Santa Flavia, Italy, 22-25 May 1978. Oxford, Pergamon Press, 1979. xxiii, 433 p.

CCP7: Glaeser, P.S. (ed.). Data for Science and Technology (Proceedings of the Seventh International CODATA Conference, Kyoto, Japan, 8-11 October 1980). Oxford, Pergamon Press, 1981. xxiii, 615 p.

CCP8: Glaeser, P.S. (ed.). Data for Science and Technology: Proceedings of the Eighth International CODATA Conference, Jachranka, Poland, 4-7 October, 1982. Amsterdam, North Holland, 1983. xv, 350 p.

CCP9: Glaeser, P.S. (ed.). The Role of Data in Scientific Progress (Proceedings of the Ninth International CODATA Conference, Jerusalem, Israel, 24-28 June, 1984). Amsterdam, North Holland, 1985. xvi, 549 p.

Two further abbreviations used in this Appendix are:-

CSDB: Hippe, Z.S., Dubois, J.E. (eds.). Computer Science and Data Banks (Papers presented at the Eighth International CODATA Conference, Jachranka, Poland, 4-7 October 1982). Warszawa, Polish Academy of Sciences, 1984. xii, 194 p.

JCICS: Journal of Chemical Information and Computer Sciences

NATURE AND VARIETY OF DATA

Bartels, H.; Hausen, U. Treatment of data in the biosciences. In: Rossmassler, S.A.; Watson, D.G. (eds.). Data handling for science and technology. An overview and sourcebook, p. 23-39. Amsterdam, North-Holland, 1980. 184 p.

Chase, M.W. Sources generating and reporting numerical factual data. In: Development and use of numerical and factual data bases. AGARD Lecture Series No. 130, p. 3.1-3.11. Neuilly sur Seine, AGARD, 1983.

Kotani, M. Data generation. In: Rossmassler, S.A.; Watson, D.G. (eds.). Data handling for science and technology. An overview and sourcebook, p. 9-22. Amsterdam, North-Holland, 1980. 184 p.

Lide Jr., D.R. Critical data for critical needs. Science, vol. 212, 19 June 1981, p. 1343-1349.

Rumble Jr., J. Nonbibliographic data banks for the physics-related areas. In: Schwarz, S.; Watson, D.G.; Alvfeldt, O. (eds.). Nonbibliographic data banks in science and technology, p. 71-76. Paris, ICSU Press, 1985. 218p.

Shapley, A.H.; Tomlinson, R. Treatment of observational data in the geosciences. Estimation and approximation of data. In: Rossmassler, S.A.; Watson, D.G. (eds.). Data handling for science and technology. An overview and sourcebook, p. 41-53. Amsterdam, North-Holland, 1980. 184 p.

Watson, D.G. Types of technical content of data. In: Development and use of numerical and factual data bases. AGARD Lecture Series No. 130, p. 2.1-2.3. Neuilly sur Seine, AGARD, 1983.

Watson, D.G. Non-bibliographic data banks applied to chemistry. In: Schwarz, S.; Watson, D.G.; Alvfeldt, O. (eds.). Nonbibliographic data banks in science and technology, p. 31-38. Paris, ICSU Press, 1985. 218p.

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